

## CLAIMS

We claim:

1           1.     A method in a wearable computer for providing information about a  
2     current state of a user of the wearable computer, the current state modeled with multiple  
3     state attributes, the wearable computer executing a plurality of state server modules to  
4     supply values for the state attributes, executing a plurality of state client modules to  
5     receive and process values for the state attributes, and executing an intermediary module  
6     to facilitate exchange of state attribute values, the method comprising:  
7                 under control of each of the executing state client modules, sending to the  
8     intermediary module a registration message indicating a current desire to receive values  
9     for at least one indicated state attribute;  
10                under control of each of the executing state server modules,  
11                receiving information from at least one input sensor;  
12                generating a current value for one of the state attributes based on the  
13     received information; and  
14                sending to the intermediary module the generated current value; and  
15                under control of the intermediary module,  
16                receiving the sent registration messages; and  
17                for each of the state server modules,  
18                receiving from the state server module the sent current value for  
19     one of the state attributes;  
20                after the receiving of the current value, determining based on the  
21     received registration messages multiple of the state client modules that currently have a  
22     desire to receive values for the one state attribute; and  
23                sending to each of the determined state client modules the  
24     received current value,

25 so that the state client modules receive values for the state attributes they have indicated  
26 when the values become available.

1                   2.     The method of claim 1 including, under the control of the  
2 intermediary module:

3                   receiving from a first of the state client modules a request for a current  
4 value of an indicated state attribute; and

5                   in response, supplying the requested value to the first state client module  
6 by,

7                   requesting at least one of the state server modules to supply a value for  
8 the indicated state attribute; and

9                   sending to the first state client module a value for the indicated state  
10 attribute received in response to the requesting.

1                   3.     The method of claim 2 wherein the intermediary module stores  
2 values for the state attributes that are received from the state server modules, and wherein  
3 the requesting of the state server modules to supply the value to be sent to the first state  
4 client module occurs only if an appropriate value for the indicated state attribute is not  
5 stored by the intermediary module.

1                   4.     The method of claim 2 wherein at least some of the state server  
2 modules send registration messages to the intermediary module, each registration  
3 message indicating a current availability to supply values for an indicated one of the state  
4 attributes, and including determining the at least one state server modules that are to be  
5 requested to supply the value for the indicated state attribute based on the registration  
6 messages from the state server modules.

1                   5.     The method of claim 1 wherein the sending of the received current  
2 value to the determined state client modules includes an indication of the state server  
3 module from which the sent current value was received.

1           6.     The method of claim 1 including, under the control of the  
2 intermediary module:

3                 receiving from a first of the state client modules an indication of a condition  
4 related to at least one of the state attributes;

5                 determining after the receiving of at least some of the sent current values  
6 whether the received current value satisfies the condition; and

7                 when it is determined that the condition is satisfied, notifying the first state  
8 client module.

1           7.     The method of claim 1 including, under the control of a first of the  
2 state client modules:

3                 receiving a sent current value from the intermediary module; and  
4                 presenting information to a user of the first state client module based on the  
5 receiving of the value.

1           8.     The method of claim 1 wherein at least some of the state server  
2 modules generate values for additional state attributes of a current state other than for the  
3 user and send those generated values to the intermediary module, and wherein the  
4 intermediary module additionally sends received values for the additional state attributes  
5 to state client modules based on received registration messages from those state client  
6 modules indicating a current desire to receive values for at least one of the additional  
7 state attributes.

1           9.     A method in a computer for providing information about a current  
2 state that is modeled with multiple state attributes, comprising:

3                 receiving from a first client an indication of an interest in receiving values  
4 for an indicated one of the state attributes of the modeled current state;

5                 receiving from a second client an indication of an interest in receiving  
6 values for another of the state attributes of the modeled current state; and

7 in response to receiving a value for the indicated one attribute from a first  
8 source,  
9 determining that the first client has an interest in receiving the  
10 received value; and  
11 supplying the received value to the first client.

1 10. The method of claim 9 wherein the receiving of the value for the one  
2 attribute from the first source includes receiving descriptive information about the  
3 received value.

1 11. The method of claim 10 wherein the descriptive information includes  
2 a time at which the received value is most accurate.

1 12. The method of claim 10 wherein the descriptive information includes  
2 a confidence factor indicating a likelihood of accuracy of the received value.

1 13. The method of claim 10 wherein the supplying of the received value  
2 to the first client includes supplying the descriptive information to the first client.

1 14. The method of claim 9 wherein the supplying of the received value  
2 to the first client includes supplying an indication of the first source.

1 15. The method of claim 9 wherein the received indication from the first  
2 client additionally includes an indication of a source for the values of the one attribute,  
3 and wherein the supplying of the received value to the first client occurs only if the first  
4 source is the indicated source.

1 16. The method of claim 9 including supplying the received value to the  
2 first client only if the received value satisfies a criteria for values supplied to the first  
3 client.

1           17.    The method of claim 9 including storing values for attributes that are  
2   received from sources so that the stored values can be later supplied to clients.

1           18.    The method of claim 9 wherein the one attribute represents  
2   information about a user of the computer.

1           19.    The method of claim 18 wherein the represented information reflects  
2   a modeled mental state of the user.

1           20.    The method of claim 9 wherein the one attribute represents  
2   information about the computer.

1           21.    The method of claim 9 wherein the one attribute represents  
2   information about a physical environment.

1           22.    The method of claim 9 wherein the one attribute represents  
2   information about a cyber-environment of a user of the computer.

1           23.    The method of claim 9 wherein the one attribute represents a current  
2   prediction about a future state.

1           24.    The method of claim 9 including receiving from the first source a  
2   registration message before receiving the value for the one attribute, the registration  
3   message indicating an ability to supply values for the one attribute.

1           25.    The method of claim 9 wherein the received indications from the  
2   first and second clients are registration messages.

1           26.    The method of claim 9 including, after receiving an indication from  
2   the first client for a value of a second indicated attribute and receiving a value from a  
3   source for the second attribute, supplying to the first client the received value for the  
4   second attribute.

1           27.    The method of claim 26 wherein the received value for the second  
2   attribute is from the first source.

1           28.    The method of claim 9 including, after receiving a value for the one  
2   attribute from a second source, supplying the received value to the first client.

1           29.    The method of claim 9 including, after receiving a value for the  
2   another attribute from a source, supplying the received value to the second client.

1           30.    The method of claim 9 wherein the received value is supplied by the  
2   first source in response to receiving by the first source of input information related to the  
3   one attribute.

1           31.    The method of claim 9 including:  
2   receiving from the first client an indication of a condition; and  
3   when it is determined that the condition is satisfied, notifying the first  
4   client.

1           32.    The method of claim 31 including determining after the receiving of  
2   the value for the one attribute whether the received value satisfies the condition.

1           33.    The method of claim 31 wherein the condition relates to a specified  
2   one of the state attributes having a specified value.

1           34. The method of claim 31 including monitoring the condition to  
2 determine when it is satisfied.

1           35. The method of claim 9 including:  
2 receiving from a client a request for a current value of a specified state  
3 attribute; and  
4 in response, supplying the requested value to the client by,  
5 requesting at least one source to supply a value for the indicated state  
6 attribute; and  
7 sending to the client a value for the indicated state attribute received in  
8 response to the requesting.

1           36. The method of claim 9 wherein the first source includes a group of  
2 instructions to be executed to produce a value for the one attribute, and including loading  
3 and executing the group of instructions in response to the receiving of the indication from  
4 the first client for a value of the one attribute, the loading and executing so that the first  
5 source can produce the first value.

1           37. The method of claim 9 wherein the first client includes a group of  
2 instructions to be executed to receive a value for the one attribute, and including loading  
3 and executing the group of instructions in response to receiving of a value for the one  
4 attribute from a source, the loading and executing before the receiving of the indication  
5 from the first client.

1           38. The method of claim 9 wherein security information must be  
2 received for a source before any values of state attributes are accepted from the source.

1           39. The method of claim 9 wherein security information must be  
2 received for a client before any values of state attributes are supplied to the client.

1           40.    The method of claim 9 wherein the state attributes are part of a  
2 predefined taxonomy of attributes.

1           41.    The method of claim 9 wherein the state attributes are dynamically  
2 defined by sources who indicate an ability to supply values for the defined attributes.

1           42.    The method of claim 9 wherein the state attributes are dynamically  
2 defined by clients who indicate an interest in receiving values for the defined attributes.

1           43.    The method of claim 9 including supplying to the first client a  
2 mediated value for the one attribute that is based on multiple received values for the one  
3 attribute.

1           44.    The method of claim 9 wherein receiving of the supplied value by  
2 the first client prompts the first client to present information to a user of the first client.

1           45.    The method of claim 9 wherein the providing of the information  
2 about the modeled current state is performed by an operating system of the computer.

1           46.    The method of claim 9 wherein the providing of the information  
2 about the modeled current state is performed by a software module, and including, upon  
3 commencement of execution of the software module, commencing execution of multiple  
4 sources that are each to supply values for at least one of the state attributes.

1           47.    The method of claim 46 wherein the multiple sources that are to be  
2 executed are determined based on previous received indications of ability to supply  
3 values for at least one state attribute.



1           48.    The method of claim 9 wherein the providing of the information  
2 about the modeled current state is performed by a software module, and including, upon  
3 commencement of execution of the software module, commencing execution of multiple  
4 client that are each to receive values for at least one of the state attributes.

1           49.    The method of claim 48 wherein the multiple clients that are to be  
2 executed are determined based on previous received indications of an indication of an  
3 interest in receiving values for at least one state attribute.

1           50.    A computer-readable medium whose contents cause a computing  
2 device to provide information about a current state that is modeled with multiple state  
3 attributes, by:

4                receiving from a first client an indication of an interest in receiving values  
5 for an indicated one of the state attributes of the modeled current state;

6                receiving from a second client an indication of an interest in receiving  
7 values for another of the state attributes of the modeled current state; and

8                in response to receiving a value for the indicated one attribute from a first  
9 source,

10               determining that the first client has an interest in receiving the  
11 received value; and

12               supplying the received value to the first client.

1           51.    The computer-readable medium of claim 50 wherein the computer-  
2 readable medium is a memory of the computing device.

1           52. A computer-readable generated data signal transmitted via a  
2 transmission medium, the generated data signal having encoded contents that cause a  
3 computer to provide information about a current state that is modeled with multiple state  
4 attributes, by:

5           receiving from a first client an indication of an interest in receiving values  
6 for an indicated one of the state attributes of the modeled current state;

7           receiving from a second client an indication of an interest in receiving  
8 values for another of the state attributes of the modeled current state; and

9           in response to receiving a value for the indicated one attribute from a first  
10 source,

11           determining that the first client has an interest in receiving the  
12 received value; and

13           supplying the received value to the first client.

1           53. The computer-readable generated data signal of claim 52 wherein the  
2 contents are encoded using a carrier wave.

1           54. A computing device for providing information about a current state  
2 that is represented with multiple attributes, comprising:

3           an attribute mapping module that is capable of receiving from a first client  
4 an indication of an interest in receiving values for an indicated one of the attributes of the  
5 current state and of receiving from a second client an indication of an interest in receiving  
6 values for another of the attributes of the current state;

7           an attribute value receiver module that is capable of receiving a value for  
8 the one attribute from a first source; and

9           an attribute value supplier module that is capable of, in response to the  
10 receiving of the value for the one attribute, determining that the first client has an interest  
11 in receiving the received value and supplying the received value to the first client.

1           55. The computing device of claim 54 wherein the attribute mapping  
2 module, the attribute value receiver module, and the attribute value supplier module are  
3 components of an intermediary module executing in memory.

1           56. The computing device of claim 54 further comprising multiple  
2 sources and multiple clients executing in the memory.

1           57. A computing device for providing information about a current state  
2 that is represented with multiple modeled attributes, comprising:

3           means for receiving from a first client an indication of an interest in  
4 receiving values for an indicated one of the modeled attributes of the current state and for  
5 receiving from a second client an indication of an interest in receiving values for another  
6 of the modeled attributes of the current state; and

7           means for, in response to receiving a value for the indicated one attribute  
8 from a first source, determining that the first client has an interest in receiving the  
9 received value and supplying the received value to the first client.

1           58. A method in a portable computer for providing information about a  
2 context that is modeled with multiple context attributes, comprising:

3           receiving from each of multiple clients an indication of a desire to receive  
4 multiple values for at least one of the context attributes of the context;

5           receiving from each of multiple sources an indication of an ability to supply  
6 values for one of the context attributes of the context; and

7           for each of the multiple sources,

8           receiving multiple values for the one context attribute for which the  
9 source has indicated the ability to supply values; and

10          after the receiving of each of the multiple values,

11 determining whether any of the multiple clients currently have a  
12 desire to receive values for the one context attribute for which the source has indicated  
13 the ability to supply values; and

14 when at least one of the multiple clients is determined to have the  
15 desire, sending the received value to each of the determined clients.

1 59. The method of claim 58 including, after sending of a received value  
2 for a first attribute to each of the clients determined to currently have the desire to receive  
3 values for the first attribute:

4 receiving from a first client an indication of a desire to receive values for  
5 the first attribute, the first client not one of the multiple clients; and

6 after the receiving of a next value for the first attribute, sending the received  
7 next value to the first client.

1 60. The method of claim 58 including, after sending of a received value  
2 for a first attribute to each of the clients determined to currently have the desire to receive  
3 values for the first attribute:

4 receiving from one of the determined clients an indication of a lack of  
5 desire to receive values for the first attribute; and

6 after the receiving of a next value for the first attribute, sending the received  
7 next value to a group of clients that does not include the one determined client.

1 61. The method of claim 58 wherein the context attributes represent  
2 information about a user of the portable computer.

1 62. The method of claim 58 wherein the context that is represented is a  
2 current context.

1 63. The method of claim 58 wherein the received indications from the  
2 multiple sources and multiple clients are registration messages.

1           64.    The method of claim 58 including:  
2           receiving from a first client an indication of a condition; and  
3           when it is determined that the condition is satisfied, notifying the first  
4   client.

1           65.    The method of claim 58 wherein receiving of the sent value by the  
2   client prompts the client to present information to a user of the client.

1           66.    A computer-readable medium containing instructions that when  
2   executed cause a computing device to provide information about a context that is  
3   modeled with multiple context attributes, by:

4           receiving from each of multiple clients an indication of a desire to receive  
5   multiple values for at least one of the context attributes of the context;

6           receiving from each of multiple sources an indication of an ability to supply  
7   values for one of the context attributes of the context; and

8           for each of the multiple sources,  
9           receiving multiple values for the one context attribute for which the  
10   source has indicated the ability to supply values; and

11           after the receiving of each of the multiple values,  
12           determining whether any of the multiple clients currently have a  
13   desire to receive values for the one context attribute for which the source has indicated  
14   the ability to supply values; and

15           when at least one of the multiple clients is determined to have the  
16   desire, sending the received value to each of the determined clients.

1           67.    A portable computer for providing information about a context that  
2   is represented with multiple attributes, comprising:

3           an attribute mapping module that is capable of receiving from each of  
4   multiple clients an indication of a desire to receive multiple values for at least one of the

5 attributes of the context and of receiving from each of multiple sources an indication of  
6 an ability to supply values for one of the attributes of the context; and

7 an attribute value supplier module that is capable of receiving from each of  
8 the multiple sources multiple values for the one attribute for which that source has  
9 indicated the ability to supply values, of determining for each received value for an  
10 attribute whether any of the multiple clients currently have a desire to receive values for  
11 that attribute, and of sending the received value to each of the clients that are determined  
12 to have the desire.

1 68. A computer-implemented method for providing information about a  
2 current state that is modeled with multiple state attributes, each of the state attributes  
3 having multiple sources available to supply values for the attribute, comprising:

4 sending to an intermediary module an indication of one of the state  
5 attributes;

6 receiving from the intermediary module a first value for the indicated state  
7 attribute that was supplied from a first source, the first value sent from the intermediary  
8 module based on the sent indication and in response to the first value becoming available  
9 to the intermediary module;

10 receiving from the intermediary module a second value for the indicated  
11 state attribute that was supplied from a second source, the second value sent from the  
12 intermediary module based on the sent indication and in response to the second value  
13 becoming available to the intermediary module;

14 receiving from the intermediary module a third value for the indicated state  
15 attribute that was supplied from the first source, the third value sent from the  
16 intermediary module based on the sent indication and in response to the third value  
17 becoming available to the intermediary module; and

18 using at least one of the received values to perform processing based on the  
19 modeled current state.

1           69.    The method of claim 68 wherein the processing based on at least one  
2 of the received values includes presenting information to a user.

1           70.    The method of claim 68 including sending to the intermediary  
2 module an indication of another of the state attributes and receiving in response from the  
3 intermediary module multiple values for the another state attribute.

1           71.    The method of claim 68 including:  
2            sending to the intermediary module an indication of a condition related to a  
3 value of at least one of the state attributes; and  
4            receiving an indication from the intermediary module that the condition is  
5 satisfied.

1           72.    A computer-readable medium whose contents cause a computing  
2 device to provide information about a current state that is modeled with multiple state  
3 attributes, at least some of the state attributes having multiple sources available to supply  
4 values for the attribute, by:

5            sending to an intermediary module an indication of one of the state  
6 attributes;

7            receiving from the intermediary module a first value for the indicated state  
8 attribute that was supplied from a first source, the first value sent from the intermediary  
9 module based on the sent indication and in response to the first value becoming available  
10 to the intermediary module;

11           receiving from the intermediary module a second value for the indicated  
12 state attribute that was supplied from a second source, the second value sent from the  
13 intermediary module based on the sent indication and in response to the second value  
14 becoming available to the intermediary module;

15           receiving from the intermediary module a third value for the indicated state  
16 attribute that was supplied from the first source, the third value sent from the

intermediary module based on the sent indication and in response to the third value becoming available to the intermediary module; and

using at least one of the received values to perform processing based on the modeled current state.

73. A computing device for providing information about a current state that is modeled with multiple state attributes, each of the state attributes having multiple sources available to supply values for the attribute, comprising:

a first module capable of sending to an intermediary module an indication of one of the state attributes;

a second module capable of receiving from the intermediary module a first value for the indicated state attribute that was supplied from a first source, the first value sent from the intermediary module based on the sent indication and in response to the first value becoming available to the intermediary module, of receiving from the intermediary module a second value for the indicated state attribute that was supplied from a second source, the second value sent from the intermediary module based on the sent indication and in response to the second value becoming available to the intermediary module, and of receiving from the intermediary module a third value for the indicated state attribute that was supplied from the first source, the third value sent from the intermediary module based on the sent indication and in response to the third value becoming available to the intermediary module; and

a third module capable of using at least one of the received values to perform processing based on the modeled current state.

74. A computer-implemented method for providing information about a current state that is modeled with multiple state attributes, each of the state attributes having multiple sources available to supply values for the attribute, comprising:

sending to an intermediary module a registration message indicating an ability to supply values for an indicated one of the state attributes of the modeled current state; and



7 for each of multiple pieces of input information about a current state,  
8 receiving the input information; and  
9 in response to the received input information,  
10 determining if the received input information is sufficient to  
11 generate a value for the one state attribute;  
12 when it is determined that the received input information is  
13 sufficient, generating a value for the one state attribute based at least in part on the  
14 received input information;  
15 when it is determined that the received input information is not  
16 sufficient, attempting to retrieve additional input information that is sufficient to generate  
17 a value for the one state attribute; and  
18 after the generating of a value for the one state attribute, sending  
19 to the intermediary module an indication of the generated value so that the intermediary  
20 module can supply the generated value to a client having an interest in receiving values  
21 for the one state attribute.

1 75. The method of claim 74 including generating an uncertainty value  
2 associated with accuracy of the generated value, and wherein the sending of the  
3 indication of the generated value includes an indication of the generated uncertainty  
4 value.

1 76. The method of claim 74 including determining an effective time at  
2 which the generated value is most accurate, and wherein the sending of the indication of  
3 the generated value includes an indication of the determined effective time.

1 77. The method of claim 74 wherein the input information is received  
2 from a sensor.

1 78. The method of claim 74 including:

2           sending to the intermediary module a registration message indicating an  
3   ability to supply values for another one of the state attributes;  
4           generating a value for the another state attribute based at least in part on  
5   received input information about the modeled current state, and  
6           sending to the intermediary module an indication of the generated value for  
7   the another state attribute.

1           79.   A computer-readable medium whose contents cause a computing  
2   device to provide information about a current state that is modeled with multiple state  
3   attributes, each of the state attributes having multiple sources available to supply values  
4   for the attribute, by:

5           sending to an intermediary module a registration message indicating an  
6   ability to supply values for an indicated one of the state attributes of the modeled current  
7   state; and

8           for each of multiple pieces of input information about a current state,  
9           receiving the input information; and  
10          in response to the received input information,

11          determining if the received input information is sufficient to  
12   generate a value for the one state attribute;

13          when it is determined that the received input information is  
14   sufficient, generating a value for the one state attribute based at least in part on the  
15   received input information; and

16          after the generating of a value for the one state attribute, sending  
17   to the intermediary module an indication of the generated value so that the intermediary  
18   module can supply the generated value to a client having an interest in receiving values  
19   for the one state attribute.

1           80.    A computer system for providing information about a current state  
2 that is modeled with multiple state attributes, each of the state attributes having multiple  
3 sources available to supply values for the attribute, comprising:

4                a first module capable of sending to an intermediary module a registration  
5 message indicating an ability to supply values for an indicated one of the state attributes  
6 of the modeled current state; and

7                a second module capable of, for each of multiple pieces of input  
8 information about a current state,

9                        receiving the input information; and

10                      in response to the received input information,

11                      determining if the received input information is sufficient to  
12 generate a value for the one state attribute;

13                      when it is determined that the received input information is  
14 sufficient, generating a value for the one state attribute based at least in part on the  
15 received input information; and

16                      after the generating of a value for the one state attribute, sending  
17 to the intermediary module an indication of the generated value so that the intermediary  
18 module can supply the generated value to a client having an interest in receiving values  
19 for the one state attribute.